DOCUMENT RESUME

ED 345 685 IR 015 491

AUTHOR Kari, Jouko; Nojd, Olavi
TITLE Interactive Video in Teaching. Theory into Practice. Publication Series B 62.
INSTITUTION Jyvaskyla Univ. (Finland). Inst. for Educational Research.
PUB DATE 91
NOTE 62p.; A trailing ten-page list of Institute for Educational Research publications in small type on colored paper will not reproduce well.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Art Education; Elementary Education; Foreign Countries; *Interactive Video; Intermode Differences; *Learner Controlled Instruction; Learning Theories; Science Education; Student Attitudes; Student Motivation; Student Participation; Teacher Role; *Videodisks
IDENTIFIERS *Finland

ABSTRACT

This report describes research on the use of interactive video in elementary schools which was carried out in the comprehensive school at the Institute for Education Research and the Department of Teacher Education in the University of Jyvaskyla, Finland. The research is based on students' attitude ratings of different working modes in the comprehensive school and observations videorecorded in learning situations where students worked with interactive video. The students rated interactive video as a very popular working mode in science and art education. The observations of the videorecorded learning situations indicated a very high activity level and few cases of disturbing behavior among students. This research showed that interactive video will change the role of teachers and teaching materials. The student will actively search for and modify information with the new medium, thereby taking a measure of control over learning. It was found that levels of student participation in and motivation for learning increased through the use of interactive video. Nine of the 26 references listed are in Finnish, most of them with English summaries. A student response sheet is appended. (Author/DB)

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INSTITUTE FOR EDUCATIONAL RESEARCH. PUBLICATION SERIES B

ED345685

Theory into practice 62

Jouko Kari — Olavi Nöjd

INTERACTIVE VIDEO IN TEACHING

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Kasvatustieteiden tutkimuslaitoksen julkaisusarja B. Teoriaa ja käytäntöä 62
Institute for Educational Research. Publication series B. Theory into practice 62
Pedagogiska forskningsinstitutet. Publikationsserie B. Teori och praxis 62

INTERACTIVE VIDEO IN TEACHING

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Kasvatustieteiden tutkimuslaitos, Jyväskylä
1991

ISBN 951-680-497-7
ISSN 0782-9817
Jyväskylän yliopiston monistuskeskus
Kirjapaino Oy Sisä-Suomi (kannet)
1991

ABSTRACT

Kari, J. - Nöjd, O. 1990. Interactive video in teaching. The University of Jyväskylä. Institute for Educational Research. Publication series B: Theory into practice 62.
ISBN 951-680-497-7
ISSN 0782-9817

The report describes research on the use of interactive video in the comprehensive school, carried out at the Institute for Educational Research and the Department of Teacher Education in the University of Jyväskylä. The research is based on pupils' ratings of different working modes in the comprehensive school and observations videorecorded in learning situations where pupils worked with interactive video. The pupils rated interactive video as a very popular working mode in science education and art education. The observations of the videorecorded learning situations indicated a very high activity level and few cases of disturbing behaviour among pupils. This research showed that interactive video will change the role of teachers and teaching materials. The pupil will actively search for and modify information with the new medium.

Descriptors: learning, multimedia, interactive video, comprehensive school, art education, science education

PREFACE

Interactive learning is a multiple sequence process of learning rather than merely a matter of using new technology. The pupil receives information mediated by the new technology, and uses the new technology to modify the information.

The role of learning material will change. In future we do not produce pre-planned course material to be learned and remembered according to a pre-planned curriculum. The pupil will be an active and creative modifier of information. The learner needs new kinds of information sources and knowledge on how to rearrange and organize the information in a subject area. On one optical disc we may collect all textbooks, teachers' manuals, workbooks, maps, slides etc. for all comprehensive school grades and subject areas. The learner's task is to find the information needed by using a suitable searching system and by arranging it in a suitable order. The role of an optical delivery system will be to complement textbooks, manuals, audio-visual soft-ware. Of course printed materials can also be used interactively. We have to reconsider the relevance of the contemporary system of teaching material production. Today we print nearly similar textbooks for every pupil. They contain information already classified and arranged in accordance with the curriculum. It has been the easiest way to solve the software problem of the schools.

"The demand for meaningfulness in learning tasks presupposes that the teacher has a clear understanding of the pupils, the quality of the learning task and the proper subject matter for implementing a particular learning task" (Sajavaara 1990 91).

For that reason the purpose of this research was to examine how pupils of the comprehensive school experienced the new interactive media and the possibilities it offers for self-improvement. If the results can be generalized to different learning materials with different contents, so much the better. In the same way as language learning may be very comprehensive (according to the communicative theory of language learning), so may also science and art education appeal to the pupil with their rich versatility and thus have a deep effect on the pupil.

The affective and the cognitive goals are important when we try to encourage pupils to learning outcomes that will make the pupil act and enjoy the results like an explorer. Therefore we have to develop curricula, textbooks and especially new media which can improve learners' ability to construct their own problems. We have to be more appreciative of pupils' own initiativeness in learning situations. Interactive learning materials allow greater creative participation in the learning process.

The ideas and working modes of a "new school" can be introduced into the Finnish school with the new interactive media.

The computers as a tool and the interactive media with carefully planned - not programmed - learning materials, will become a vital educational aid in the near future.

The esthetic point of view, as a dynamic and influencial element of general culture, will be emphasized in education. Today a great deal of information is mediated by the visual media. One central aspect of the courseware problem is that the growth of the amount of information does not automatically increase the amount of real knowledge. Human resources for organizing and understanding reality require more help than before, when information supply was less substantial than now.

The nature of entertainment and the craving for sensation in the mass media may make the pupil numb for deeper learning experiences in cognitive and esthetic learning. These problems are a challenge, which we have to meet. Already today experiments and research concerning the interactive media show that pedagogically well-planned interactive software can be the remedy for the situation. (Erstellung und unterrichtliche Erprobung der Bildplatte 1989). In values education we have to concentrate on vital objectives.

We are grateful to the following institutions, which have supported our project: the National Board of General Education (the Department of Teaching Materials), the National Audiovisual Center and Nokia Data Systems.

The Jyväskylä University Association donated an interactive video hardware system to our project for which we are truly grateful.

We are also grateful to the following persons, who helped our project: Ulla Aho, who analyzed the videotapes, Liisa Hughes, who made corrections to the English in the report, Seija Nöjd, who planned the art education teaching sequences, Tuomo Nöjd, who prepared the computer programming and Oiva Ylinentalo who helped us in computer graphics.

Jouko Kari Olavi Nöjd

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1. INTRODUCTION

1.1. The background of the research

The Ministry of Education set up a videocommittee in 1982. The task of the committee was "to draw up suggestions for cultural, educational and mediapolicy measures to be taken by the state". The committee handed in its last report (part 5) "Video workshops and interactive media" at the end of 1989. The committee made proposals for research on interactive media. It recommended the Institute for Educational Research at Jyväskylä University as one possible institution for interactive media research.

Research on interactive video began at the Department of Teacher Education and the Institute for Educational Research in 1986. Teaching experiments were carried out at the primary level of the comprehensive school and in teacher education.

2

2. THE THEORETICAL FRAME OF REFERENCE

2.1. Different theoretical models of teaching and interactive video

In experimenting with interactive video in teaching, it is very important to first consider some theories of learning psychology. After that the results of this report can be evaluated more validly from the viewpoint of comparable educational situations.

In the Dutch Open university, for example, the main reason for the use of interactive video is the **individualized teaching-learning-process.** It means maximum freedom of starting moment, pace, and place. Technical facilities made it possible, said professor Gastkemper, head of the Institute for Educational Technology, Open university of the Netherlands since 1984 (Gastkemper 1987). This implies that for a given educational situation all possible media, varying from print and electronics to people, have to be considered equally for applicability and educational functionality (Romiszowski 1981).

In General:

I. Interactive video can be used as **a supplement to other accepted educational methods.**

II. Interactive video leads naturally to **multi-media (media-mix) solutions for educational problems.** Very important functionally is the well-balanced and integrated use of different media for different educational tasks and functions.

Empirical findings show that students have individual preferences for learning by means of a specific medium. These preferences do not on average lead to statistically significant differences in learning results (Gastkemper 1987). Gastkemper differentiates six general factors to be taken into consideration before a balanced choice of working modes can be made:

- the intended educational situation
- objectives of learning
- characteristics of the learners involved
- events (or functions) of needed instruction
- attributes (or possibilities) of media as needed and
- practical aspects, including costs.

These factors imply concrete variables which had to be taken into consideration in this research. The main roles in our experiment were played by the printed text and pictures, **interactive electronic media** (the computer and interactive video) and the personal help of teachers and peers (See page 10). Interactive video may be an effective medium, if dynamic visual phenomena are the object of learning/training, and if information is needed on a phenomenon (eg. affective) which is difficult to describe and if the objective of learning is some (cognitive) skill. Then the subject matter can be structured via interactive video well enough.

Interactive video (IV) can be described as interactive use of a (personal) computer integrated with a video-disc player for learning purposes. It must be stressed that the use of interactive video must not be limited this way.

Richard N. Tucker gives a definition of interactive learning: "What I mean by interactive learning is a situation in which the course of the learning is controlled by the learner. That doesn't mean that we offer the learner a choice of four answers, three of which are wrong and then show the consequences of that choice... In industrial or military training, specific goals (particularly behavioural or skills goals) have to be built into the interactive program... In education we may have the luxury of having less goal-oriented programs." (Tucker 1990, 40-41)

In the following we consider psychologically important learning aspects or theories. The use of IV can be described on the basis of the following three **theoretical models of teaching.**

Our definition of the term interactive video is based on the new concept of learning in the Finnish school system. In the late 80's the National Board of General Education published two reports dealing with the new concepts of knowledge and learning. (Voutilainen & al. 1989; Lehtinen & al. 1989)

David Deshler and Geraldine Gay present three different theoretical models of teaching in the use of interactive video. We used the same theoretical frame of reference modified in our research (Deshler & Gay 1986):

1. The behavioural control model of teaching
2. The model of cognitive psychology and gestalt-psychology
3. The model of humanistic philosophy

2.1.1. The behaviour control model of teaching in the use of interactive video.

In his book "A practical guide to interactive video" Nicholas Iuppa gives the following definition:"...interactive video is defined as any video system in which the sequence and selection of messages is determined by the user's response to the material" (Iuppa 1984, 5). This is a very restricted definition based on the behaviour control model of teaching. The computer gives the program a branching capability, and we can call the system adaptive programmed learning. The pupil is an object of teaching - not a subject of learning - as he should be.

The behaviour control model is not accepted as a base for planning and producing learning materials and units in Finnish software production. Process objectives are more and more stressed in educational planning.

Of course we cannot reject any theoretical model. There are many author-programs for authoring interactive video learning sequences, which are purely based on a behaviour-control model of teaching. This bias has to be taken into account, when selecting author programs for the production of interactive video programs.

2.1.2. The model of cognitive psychology and gestalt-psychology in the use of interactive video.

The model of cognitive psychology and gestalt-psychology stresses the following learning sequences:

1. the pupil learns to find information in a large audio-visual database on his own terms

2. the pupil learns to critically select and modify the information, and

3. the pupil learns to use new media for the delivery of the collected and modified information to a known target group

The use of interactive video in Great Britain is more directed towards the use of structured audio-visual databases. The powerful capacity of video-discs has been used in the British "Domesday" project.

Denmark, Finland, Iceland, Norway and Sweden are represented in the Norden-90 project, which will produce an interesting interactive program for the future school. Three communities in each of the countries involved take part in the multilingual video-disc production. The video-disc shows the life and surroundings of teenagers in the Scandinavian countries. The learning activities of the pupils will be based on the learning model of cognitive psychology and gestalt psychology.

2.1.3. The model of humanistic philosophy in the use of interactive video

This model directs pupils' activity towards the development of self-esteem and the ability to express themselves by using artistic means of expression. The Institute for Educational Research has produced a video disc for teacher education called "Integrated art education". The purpose of this program is to promote working modes which are based on the model of humanistic psychology. The use of interactive video is one way of promoting learning towards the affective goals and increasing the emotional growth of children.

2.2. The impact of interactive video on pupils' active working modes

Interactive video offers a new method for recording, classifying and searching information more efficiently than before. The role of teaching materials and the role of teachers will change in the near future. The objectives of learning underline pupil's active and individual ways of searching information, and modification of problems. This will have an impact on new working modes in the school and on the planning of teaching materials.

According to Bork (1981), the greatest revolutions have been the inventing of writing, printing and computers. The latest of these initiated computer assisted learning in the U.S.A. as late as in the 1950s. Although interactive video, in which the computer plays an important role, cannot yet be compared with the use of textbooks quantitatively, we dare say, that it will spread into teaching more rapidly than any other of these innovations. The computer is a real tool in learning situations, when it is used to gain information or to modify information.

We followed Papert's footprints in our project, because we wanted children to use the computer as a tool for information searching and for problem solving; we

wanted to give the child the freedom from the control of the computer (Papert 1982). The learning process is of great importance in the development of the learning scheme of the child (Kari 1987, 23-36; Asikainen 1990, 25).

2.3. Research on interactive video

Research on interactive video focuses mostly on those areas where IV has been used most: military training, commercial training and point of sale applications, and public information. In most cases evaluation tends to show how effective interactive video is when compared with conventional teaching methods.

The evaluation of the use of interactive video in the US Army shows that average reduction in problem solving times is 49 per cent and reduction in the training costs can be from $120 million to $ 1.7 million (Picciotto & al 1989).

Some experiments have also been made at the university level. They have mostly been concerned with the effectiveness of the teaching method. W.H. Leonard reported an investigation "A comparison of student reactions to biology instructions by interactive videodisc or conventional laboratory" at the university level. 72 students investigated the themes 'respiration' and 'the climate' in the science laboratory. 70 students investigated the same problems with IV. The students rated both working modes. Leonard found some statistically significant differences in the use of IV compared with traditional laboratory work:

- reduction in learning time
- higher level of attention to teaching
- better understanding of the results of the experiment
- increased confidence in following the instructions
- increase in general satisfaction with the learned subject matter

The novelty effect increased differences. (Leonard 1989.)

Phillips, Hannafin and Tripp examined the combined effects of orienting activities and levels of practice on learning from interactive video. They used the videodisc "Tour of the National Gallery of Art", which presents characteristics of various artists and art periods. The study showed that practice with interactive video increases the amount of facts remembered and develops the ability to apply knowledge. The orienting activity prior to each instructional segment had no statistically significant effects. (Phillips, Hannafin & Tripp 1988.)

Hannafin and Colamaio reported the study on "The Effects of Variations in Lesson Control and Practice on Learning from Interactive Video". The IV Software used was the American Heart Association videotape, "Project Lifesaver" to introduce the cardiopulmunar resuscitation procedure. Three kinds of variations in lesson control were used: linear program, designer control program and learner control program. In the designer control program there was one "skip branching" item after every wrong answer (review of the video sequence). In the learner control version the learner was able to choose the review sequence if he or she wanted to. The designer control version and the learner control version were more efficient than the linear version. The practice treatment increased the learning of facts and the ability to solve problems. This and the previous study represent the use of the behaviour control model of teaching. (Hannafin & Colamaio 1987.)

Laurillard studied interactive video and the control of learning in 1984. She used the computer controlled video casette and the teaching package module "Signals in communication". The students were allowed to control the learning sequences by choosing the video sequence or the computer assisted learning practice. They could also decide how many exercises to do. Laurillard concludes as a result of this study that "students can make full use of most aspects of control, and moreover make use of it in such a variety of ways that it becomes clear that program control must seriously constrain the individual preferences of students". (Laurillard 1984.)

3. THE OBJECTIVES AND PROBLEMS OF THE RESEARCH

The main objective of this research was to develop new working modes which will lead the pupils to active information searching from the optical information sources at their own initiative. For that purpose we developed a simple interface program for elementary school children.

The second objective was to examine the pupil's attitudes toward interactive media.

The third objective was to examine the affective elements of learning, the activity level of the children and social interaction of the pupils.

The fourth objective was to examine the questions that pupils asked on the basis of the video disc information.

The fifth objective was to try out different hardware configurations and their suitability for interactive media.

With this research we tried to test the following statements:

1. Interactive video will **activate** the pupils.
2. Interactive video will **motivate** the pupils and develop a positive attitude toward learning.

In addition we examined the emotional responses of the pupils.

4. THE RESEARCH METHOD

4.1. The research design

The hardware of interactive video consisted of

- a microcomputer with an interface card (Mikromikko 3TT and MIC-3000-interface card)
- a videodisc-player (laser-vision) Philips VP 405
- a multipurpose monitor (Sony KX-14CP1 monitor for data- and video-signal)
- an interface program: Own production with MIC-3000-system and Turbo Pascal

In the comprehensive school experiment we used another, simpler interactive video system, which consisted of

- a computer: Amstrad PC,
- a videodisc player: Philips VP-835 and
- a Tv-monitor Philips.
- two screens - a computer screen for computer output and a tv-monitor for the video picture.
- an interface program: Own production with GWBASIC.

The capacity of a laser-vision videodisc is 54 000 still pictures (either side), consisting of slides, graphics, maps, text etc. or 30 min. video sequences. Still-pictures are free from any flicker and the searching time of any picture is below 3 seconds. We produced interface-programs for laser-vision discs with Turbo-Pascal or GW-basic programming language.

Video discs:

In our investigation we used two laser-vision videodiscs: "The British garden birds" and "Vincent van Gogh".

Target group:

Pupils of the Practice School of the Department of Teacher Education at the University of Jyväskylä (grades 1-6 of comprehensive school)

TABLE 1. *The experimental groups working with interactive video 1989-90 (N=197)*

Experiments 1989		**Experiments 1990**	
Grades	Pupils (n)	Grades	Pupils (n)
III a	17	I a	15
IV c	23	III a	15
V a	19	IV a	15
VI b	22	IV c	16
		V b	22
girls	35	V c	11
boys	46	VI c	22
total	81	girls	54
		boys	62
		total	116

Experimental setting:

Pupils worked in groups of six in the biology class. There were three groups and the pupils circulated in each of them. Every group had its own objectives of learning.

Group 1 worked investigating characteristic features of some birds (6 birds) in **the zoological museum** or using the bird collection of the school. Objectives: to recognize these birds in nature. All the groups had visited the zoological museum.

Group 2 learned ornithological facts about birds with the aid of **bird books.** Objectives: To make pupils familiar with the nesting, distribution etc. of different kinds of birds.

Group 3 learned the ways of living of 6 kinds of birds with the aid of **interactive video** (The British Garden Birds). One of the general objectives was to make the pupils familiar with the new learning medium and new ways of working. The teacher was no more the main source of information. Most pupils were familiar with computers. The sequences on the video-disc gave information about nesting,

gathering food, brooding, feeding brood etc. The pupils had the possibility to view still-pictures, slow down the movement, play back once again etc. The pupils had a possibility to be investigators. The interface program was very simple. Even the pupils in the first grade easily learned to control the video sequences.

The tasks of every group were printed on a work sheet. At the beginning the tasks were restrictive. Later the pupils constructed their own problems.

All the learning sequences with interactive video were recorded with a video camera. The video picture shows simultaneously the bird-video sequences and the student responses.

4.2. The analysis of pupils' responses

The items of observation:

01 A positive attitude to the work task indicated by responses of gladness (smiling, expressing one's joy about a video sequence etc.)

The amount of glad responses
1. no responses of gladness 2. one response of gladness 3. two or more responses of gladness

02 The level of activity
1. passive 2. active 3. very active

03 The amount of responses of fear
1. no responses of fear 2. one response of fear 3. two or more responses of fear

04 The amount of disorders
1. no disorder 2. one response of disorder 3. two or more responses of disorder

05 The amount of asking for help or receiving help from other pupils
1. doesn't ask for help 2. asks for help once 3. asks for help twice or more often

06 The amount of asking for help or receiving help from the teacher
1. doesn't ask for help 2. asks for help once 3. asks for help twice or more often

12

07 The amount of asking other pupils or the teacher for help concerning the use of the computer
1. doesn't ask for help 2. asks for help once 3. asks for help twice or more often

08 The amount of helping other pupils
1. doesn't help others 2. helps once 3. helps twice or more often

09 The amount of teacher's help to the whole group
1. doesn't help 2. helps once 3. helps twice or more often

In order to interpret the quantitative results we analyzed the characteristics of the video-disc (Appendix 1).

4.3. Pupils' attitudes toward the working modes in the school

The pupils rated different working modes with a Likert-type rating scale. The rating scale was designed for elementary school children (Appendix 2.) The idea of using pictures and the pictures in the rating scale are from Uusikylä & Kansanen (1988).

The following working modes were rated:

1. individual work 2. visiting the zoological museum 3. interactive video and 4. group work (the pupils were familiar with group work, which is very frequently used in this school)

4.4. The analysis of the questions asked by pupils

The pupils formulated their own questions. The pupils' questions were classified according to the following categories:

1. the bird's structure
2. size
3. colour
4. ways of living
5. distribution
6. surroundings
7. food and catering for food
8. nesting and brooding
9. moving
10. enemies
11. sound and singing
12. classification of birds
13. others

5. RESULTS

5.1. Pupils' ratings of the working modes

In Figure 1 we can compare pupils' ratings of different working modes. The lowest amount of positive and the highest amount of negative ratings can be found in individual work. This is alarming because individual work is one of the most frequent active working modes in our school. One reason for the proportionally low positive rating percentage may be the quality of the questions on the work sheets. The questions too often lead to tasks requiring mostly recollection of single facts in the subject matter. The questions should be more creative, they should lead to more creative tasks and encourage pupils' initiative to construct their own problems.

Bird observation at the zoological museum is more popular than individual work as a working mode. The percentage of negative ratings is high. Maybe looking at dead birds is repulsive to some of the pupils.

The ratings of interactive video and group work are quite similar. The amount of positive ratings is very high if compared, for example, to individual work.

Perhaps these working modes give more freedom to children to do creative work. Interactive video provides possibilities to control the video information by slowing down the information rate, to stop the video sequence or to run the sequence reverse if needed. While searching for the information on the video disc the pupils may construct their own problems, and they may solve the problems with information received from the optical data bank. The use of interactive video seems to activate pupils. The learning model of cognitive psychology seems to be a good starting point for developing working methods for interactive video.

The low level of negative ratings (5%) shows the possibilities of interactive video to increase motivation toward school work. There is only a slight difference between boys and girls concerning the negative ratings of interactive video (boys 3% and girls 7%).

The attitude of boys is more often negative toward school work than the attitude of girls. Interactive video is one medium to minimize the negative attitude in general.

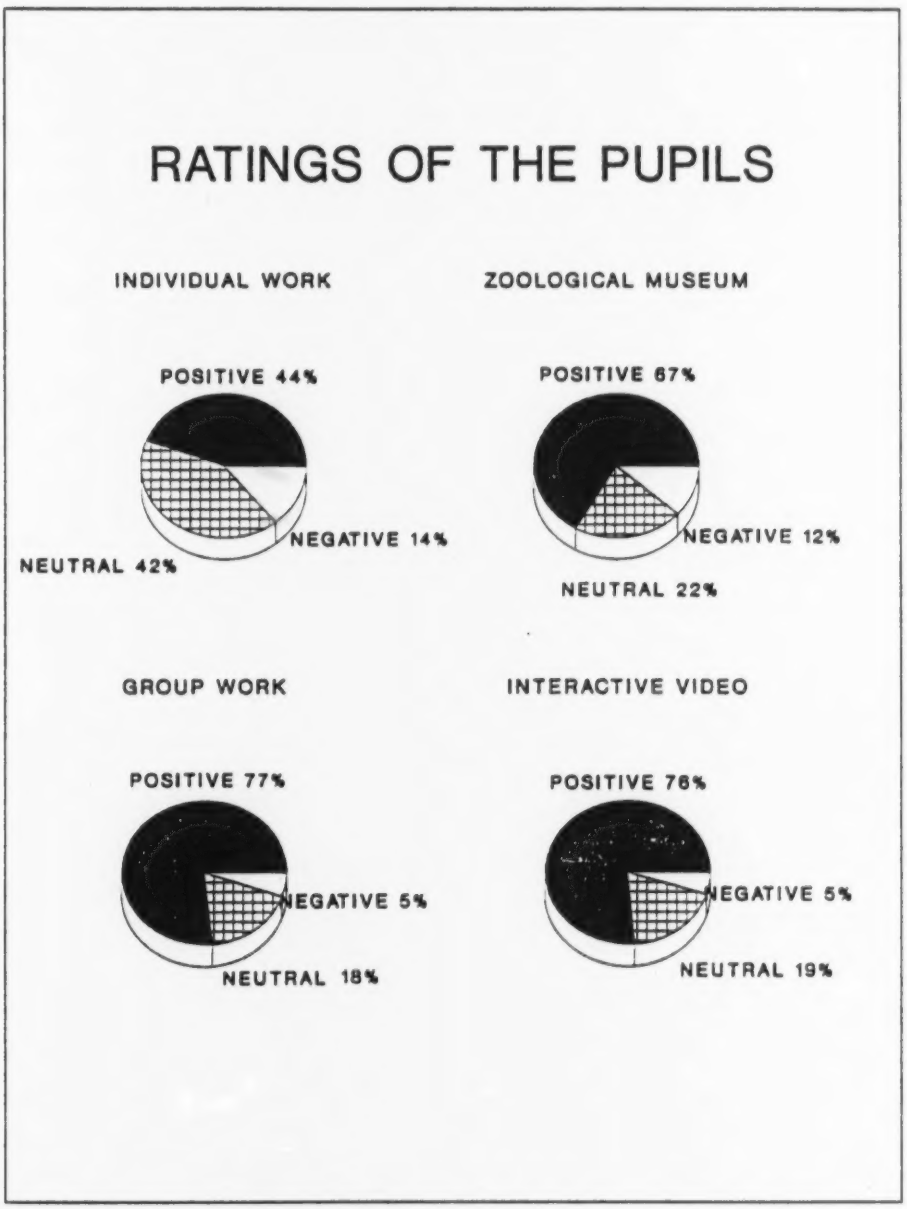

FIGURE 1. *The four working modes as rated by pupils (N=205)*

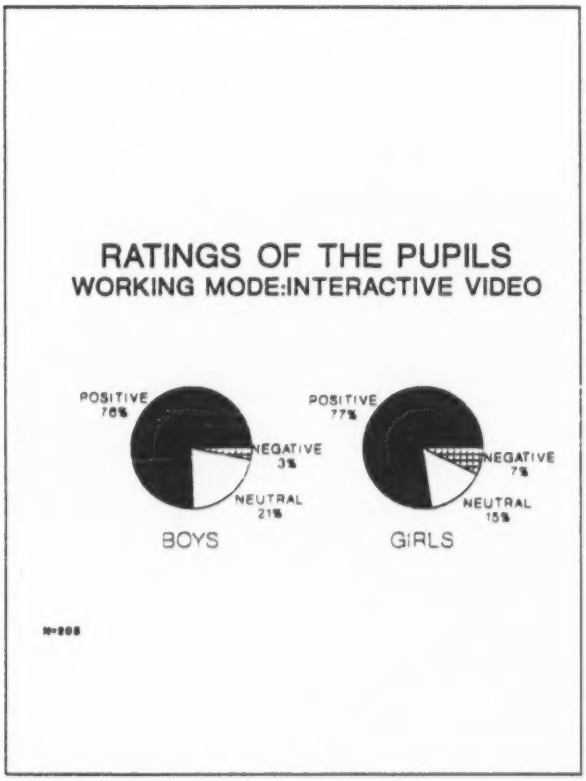

FIGURE 2. *Interactive video as a working mode rated by boys and girls*

Asikainen (1990) conducted an attitude measurement concerning pupils' attitude toward computers. She used six categories in her attitude scale: positive, positively labile, labile, negatively labile, negative and neutral.

We compared our pupils' attitudes toward interactive video to the attitudes of 10-12 year-old pupils toward computers. The following results are adopted from Asikainen (ibid).

positive and positively labile	68%
negative and negatively labile	9%
labile and neutral	23%

Pupils' attitudes toward interactive video in our research (7-12 years) were:

very positive and positive	76%
very negative and negative	5%
neutral	19%

Both attitude measurements show the same tendency: A very high amount of positive ratings and a low amount of negative ratings. Asikainen used different methods (a questionnaire and content analysis of an essay) but the similarities of results are interesting.

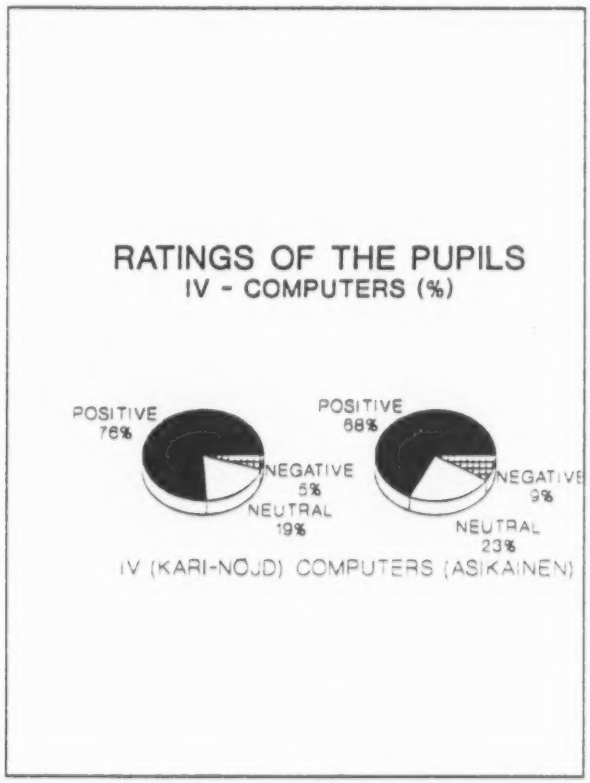

FIGURE 3. *The comparison of Asikainen's results of the pupils' attitudes toward computers in education and Kari-Nöjd's results of pupils' ratings of interactive video*

The school experiment continued for three years. Some classes worked with interactive video several times. The disappearance of the halo-effect made the results more even, but the popularity of interactive video was eminent during the three years (Fig. 4.).

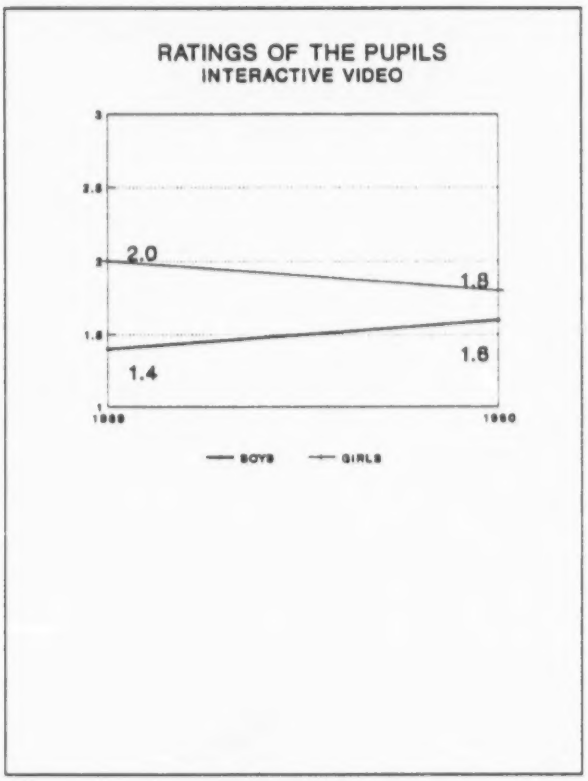

FIGURE 4. *The attractiveness of interactive video as a working mode rated by boys and girls during two successive years (1=very positive, 2=positive)*

The ratings of interactive video and group work differed. There were seven pupils who rated interactive video high but group work low and six pupils who rated group work high but interactive video low. Boys were most critical towards both popular working modes.

5.1.1. Four working modes as rated by pupils in art education

An experiment was carried out in art education with a small group of pupils. The model of humanistic psychology in the use of interactive video gave us the idea of using the following sequence of working modes in learning situations:

1. individual work
2. dramatization
3. interactive video
4. group work

Each working mode had specific goals. Individual work and dramatization sought to develop pupils' self-esteem and ability to express themselves by using artistic means of expression. In individual work, the pupils learned to imitate with crayons Vincent van Gogh's way of using the brush. In group work the pupils got information about van Gogh's life story. The pupils dramatized some important points of van Gogh's life. The interactive video visualized van Gogh's life and works and gave the pupils the possibility to analyze the paintings of van Gogh and formulate their own questions of van Gogh's art and life.

The pupils rated dramatization very high. Everybody liked the working mode (fig. 5). They dramatized some points of van Gogh's life cycle:

- van Gogh tries to get a model without money
- van Gogh tries to sell his paintings to the art shop proprietor
- people at van Gogh's grave

The pupils selected the theme and we recorded every play on the video. We have used the videotape edited from these plays in teacher education to demonstrate how to use dramatization as a learning aid. The pupils enjoyed seeing the video very much. They learned to feel empathy to Vincent van Gogh and by means of that they learned to value van Gogh's paintings.

In this experiment we used the videodisc "Vincent van Gogh". The hardware configuration was the same as in the "British Garden Birds"-experiment. In art education the pupil ratings of interactive video were very similar to the ratings of interactive video in biology learning.

The pupils analyzed the paintings in terms of what they thought was beautiful in the painting or what they thought was the emotional message of the painting. For example, the pupils analyzed the mood of Joseph Roulin (Portrait of Joseph Roulin 1888):

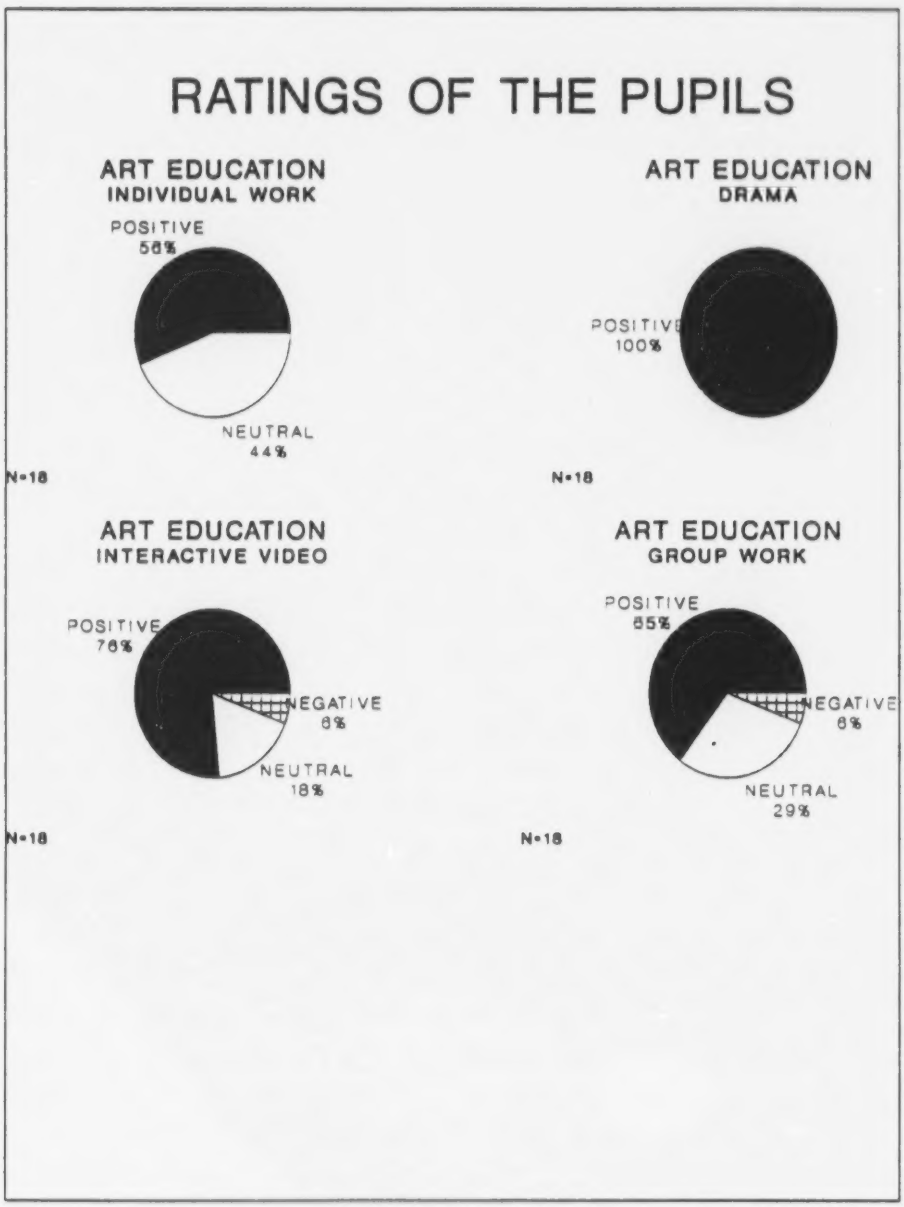

FIGURE 5. *Different working modes in art education as rated by pupils (N=18)*

"He is sad"	71%
"He is happy"	5%
"He is unkind"	13%
"He is kind"	13%

Why did Vincent paint the flowers in the background of Joseph Roulin ?

"They are decorative"	31%
"Because of the colour"	5%
"Because of the feeling"	48%
"Vincent likes Mr. Roulin"	8%

The pupils analyzed the changes in the self portraits during ten years:

the outlook changed	61%
the emotional change	8%
the change in colours	26%
different clothes	11%

We conducted the art education experiment only in one class (N=18). It is interesting to see that the concrete features of the paintings ("the outlook changed") appear most often in the pupils' analysis and the emotional aspects are very rare. Maybe the affective goals of the school are not stressed enough in the curriculum.

In art education the amount of positive ratings of group work was 12 per cent units smaller than in biology teaching. The goals in both groups were cognitive. In art education pupils gave high ratings to working modes involving more creative student activities and affective goals.

From several of Vincent van Gogh's paintings the pupils selected the one they liked best. The following paintings were most popular:

Church of Auvers	31%
Fountain in the garden of an asylum	15%
Vase with 14 sunflowers	3%
Cypresses	3%
Portrait of Joseph Roulin	3%
Self-portrait	3%

What did the pupils like in the painting "Church of Auvers"? :

the background of the church	68%
the church	58%
the colours	42%
the feeling	16%

One reason for the popularity of Vincent van Gogh is the anniversary year, and the many articles and pictures that have appeared in magazines and newspapers. There are several paintings of Vincent van Gogh hanging in the school corridors. The style of Vincent van Gogh is familiar to the pupils of this school.

5.2. The analysis of pupils' responses in biology teaching and art education with interactive video

The pupils' responses were observed from a videotape.

The amount of glad responses

The responses of gladness became apparent especially, when the bird mother took care of its brood. (See Appendix 1/04.) The amount of glad responses was small. The amount of caretaking situations on the video disc was also small.
% = the percentage of the topics observed

1. no responses of gladness	57%
2. one response of gladness	24%
3. two or more responses of gladness	19%

The level of activity

Interactive video is a very effective medium for activating pupils. 99% of the pupils were active or very active in the learning situations.

1. passive pupils	1%
2. active pupils	38%
3. very active pupils	61%

The amount of responses of fear

The amount of responses of fear was very small, possibly because of the small amount of birds of pray which could frighten the children. Loud sounds of birds aroused some responses of fear.

1. no responses of fear	98%
2. one response of fear	2%
3. two or more responses of fear	0.1%

The amount of disorders

Disturbing behavior was seldom apparent. As a disorder we classified humming or whistling a melody or irrelevant conversation.

1. no disorders	95%
2. one incidence of disorder	4%
3. two or more incidences of disorder	1%

The amount of asking for or receiving help from other pupils

Asking for help from other pupils was infrequent.

1. doesn't ask for help	81%
2. asks for help once	14%
3. asks for help twice or more often	5%

The amount of asking for or receiving help from the teacher

The interface program of interactive video tries to give pupils a possibility for independent work in groups. In the beginning the teacher has to inform pupils of the new working modes and new hardware.

1. doesn't ask for help	91%
2. asks for help once	8%
3. asks for help twice or more often	1%

The amount of asking other pupils or the teacher for help concerning the computer

The pupils were familiar with computer work. Many of them were accustomed to using a word processing program. Some classes were familiar with Logo-programming. The interface program was so simple, that there were no big problems in its use.

1. doesn't ask for help	87%
2. asks for help once	8%
3. asks for help twice or more often	5%

The amount of helping other pupils

We observed the interesting thing that the pupils' willingness to give help was stronger than their willingness to ask for help. While working in the group, the pupils tended to help slow pupils or help pupils who needed but didn't ask for help.

1. doesn't help others	68%
2. helps once	24%
3. helps twice or more often	8%

The amount of teacher's help to the whole group

At the beginning the teacher informed the whole group about the procedure of interactive video. During the working process the pupils very seldom needed help.

1. doesn't help the whole group	59%
2. helps the whole group once	33%
3. helps twice or more often	8%

5.3. The quality of the questions asked by the pupils

One way to observe the learning process is to try to find out what kind of problems or questions are important to pupils after they have seen the information material.

The pupils formulated their own questions to each other after they had answered the questions on the answer sheet. The pupils' own questions were different after working with interactive video compared to the questions they

formulated after working with printed material. The following table shows the types of questions pupils asked.

TABLE 2. *The nature and contents of the pupils' questions*

	After IV (n)	After printed material (n)
The structure of the bird	39	25
Size	2	26
Colour	84	63
The ways of living	29	0
Distribution	0	8
Surroundings	8	33
Food and catering for food	26	26
Nesting and brooding	46	67
Moving	5	3
Enemies	0	0
Sound and singing	21	36
Classification of birds	14	4
Others	5	11

Some years ago an important objective of biology teaching and ornithology was to give information on how to recognize birds in nature. The objectives of biology teaching today are more directed towards learning the ecological factors, the surroundings, nesting and brooding of the birds. The new objectives can be achieved more easily with interactive video.

The structure, size, colour, sound and classification of the birds were of great importance in the old biology syllabus. The structure and colour interested the pupils after both working modes. The old syllabus and old types of learning materials have contributed to this. The ecological surroundings, the ways of living, food and nesting are important in the new biology syllabus. The remarkable difference between the two working modes was that the pupils working with IV asked 29 questions about birds' ways of living while the bird-book group did not ask any questions about the same area.

The impact of the old objectives and old teaching materials can be seen in the questions asked by the pupils. Our experience shows that interactive video can be the medium which will develop pupils' ability to formulate more extensive questions. This is too short an experiment for generalizations, but it shows that this area will be very important for future research.

6. FEATURES OF THE VIDEODISC HARDWARE AND THE INTERFACE APPLICATIONS

The new interactive video technology offers a very large range of possibilities to choose from. The teacher meets situations which are new and difficult to manage. We recorded the critical experiences with the hardware configurations used in our teaching situations.

We deliberately selected hardware configurations of different price and quality level. The schools seldom have possibilities to purchase an integrated videodisc delivery system (e.g. Sony View System, BBC Acorn System etc.) because of high prices.

In our experiment at the Practice School in Jyväskylä we built a simple system. The PC computer was connected to the videodisc player with a serial connection cord, and the video signal and audio signal were sent from the videodisc player to the monitor with a SCART cable or video- and audio-cables. An ordinary TV-receiver was used as a monitor. The video disc picture was seen on the TV-monitor and the data-picture on the computer screen. The pictures could not be mixed. A large TV-picture was an advantage in group work - better than a small size computer screen.

An inexpensive hardware configuration demands much more programming time and capacity than, for example, the Videologic DVA-4000 system. The Videologic DVA 4000-card serves as a video digitizer board and gives the possibility to modify the picture presentation. It contains many ready-built procedures needed in the flexible programming of interactive video programs.

7. DISCUSSION

In our experiment we used interactive video as an integral part of a multiple sequence process. The pupils were active in seeking information from the video disc.

The role of the learning material changed from the conventional learning material. The pupils were able to control the amount of information by slowing down the information rate or stopping the video sequence. They could also select the birds from the video disc. This new technology gave the pupils a means of working according to the principles of the learning model of cognitive psychology. Both in biology learning and art education the affective elements were positively prominent.

This research showed that pupils at the primary level can be activated and highly motivated with an interactive medium.

The Norden -90 project will give us a possibility to do experiments with interactive video at the lower and upper secondary levels next year.

Vauras and von Wright (1985) have been able to show that: **if there are many discipline problems in the class, the pupils are not able to deep process the subject matter to be learnt.** Therefore, active and motivating "small group or individual work" with interactive video may in future prove a means by which the quality of learning can be improved, especially if the student's internal motivation is simultaneously high. This is what happened also in Kari and Suonperä's (1983) Critical Incident Observation studies when long jump, for example, was learned by means of the video.

There are no videodiscs for comprehensive school or secondary level produced in Finland. Now and in the near future we have to make interface programs for video-discs made abroad and try to adapt them to our curriculum. Our next task will be to integrate language learning to biology, science and art education at the lower secondary and upper secondary levels. The integrating medium will be an interactive videodisc with a foreign language sound channel. Today the amount of commercially distributed laser-vision videodiscs is increasing. The index of the Interactive Video Courseware Catalogue 1990 of the National Interactive Video Centre contained 280 program titles (NIVC 1989). Next year there will be 80 items more. Our opinion is that we cannot wait for the new CD-ROM XA, DVI, or CD-I systems. It may take two or three years before we can get new software distributed in any of these systems. During that time we have to gather information about the impact of interactive video on the learning process with laser-vision discs.

SUMMARY

The videocommittee set up by the Ministry of Education made proposals for research on interactive media in 1989. The National Board of General Education supported the Institute for Educational Research in developing interactive learning materials and in studying the impact that new learning materials used with new technology have on the learning process.

Three different theoretical learning models were discussed in the use of interactive video: 1. The behavior control model of teaching 2. The model of cognitive psychology and gestalt psychology 3. The model of humanistic philosophy.

Contemporary research of interactive video deals mostly with training applications and public information. In our research the main objective is to develop a multiple sequence process where interactive video will be an integral part. According to the models of cognitive psychology and gestalt psychology the pupil learns to find information from the video disc and to select critically and to modify the information. In art education the model of humanistic psychology was used. Individual work and dramatization combined to work with interactive video tried to develop pupils' self esteem and ability to express themselves by using artistic means of expression.

During the years 1989 and 1990, 197 comprehensive school pupils at the Practice School of the Department of Teacher Education at the University of Jyväskylä used different working modes in biology and art education. The pupils rated interactive video, group work and dramatization as the most popular working modes. According to the results of video observations, working with interactive video keeps the activity level of pupils very high and the amount of disturbing behavior very low.

This developmental research showed that interactive video can change the role of teaching materials. In future the pupil will be an active and creative modifier of information delivered with the new medium. The role of the textbook will change, because pupils will themselves learn to arrange the received information, construct their own problems and modify the information.

During the year 1990 the Scandinavian interactive video project Norden -90 will be completed. Our purpose is to study, how Norden -90 teaching materials can improve the learning process at the lower secondary level. During this decade the new hardware systems for interactive video will be at our disposal: CD-ROM XA, DVI and CD-I etc. The new systems will hardly dramatically change the theoretical

learning models compared to those used vith laser-vision system. It is very important to develop the pedagogical use of the promising technology while waiting for the development of future systems of interactive video.

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APPENDIX 1.

Analysis of the characteristics of the video disc "The British Garden Birds"

Variables for the analysis:

The surroundings of the bird:

01 quiet - noisy
1. only the sound of one bird can be heard 2. only weak sounds of other birds 3. bird sounds but no noises 4. disturbing noises can be heard 5. loud noises can be heard

02 idyllic surroundings - urban polluted surroundings
1. many beautiful natural surroundings 2. some beautiful natural surroundings 3. neutral surroundings 4. town surroundings 5. polluted town surroundings

03 dangerous - safe
1. very safe natural surroundings 2. fairly safe natural surroundings 3. neutral surroundings 4. the surroundings seem to be dangerous 5. the surroundings are dangerous (dangerous animals can be seen)

The bird:

04 the behaviour of the bird is friendly - unfriendly
1. caring activities of the bird 2. the bird seems to be friendly 3. neutral behaviour 4. the bird seems to be dangerous 5. the bird behaves aggressively

05 the volume of the bird sound
1. the sound of the bird is quiet 2. the sound of the bird is rather quiet 3. the sound of the bird is loud 4. the sound of the bird is very loud

06 the beauty of the bird song
1. very beautiful 2. beautiful 3. neutral 4. ugly 5. very ugly

07 the types of video picture shots: close up - long shot
1. an extreme close-up 2. the bird fills the whole screen 3. few close-up shots 4. the bird in the bakground quite small 5. long shots

08 the bird alone - birds in big groups
1. all the time alone 2. small groups of 2-3 birds 3. the bird in a group of 5-10 birds 4. the bird sometimes in a group of over 10 birds 5. sometimes in very big groups

APPENDIX 2.

The questionnaire:

Write your name, please _____

Grade _____

In the pictures the girl and the boy are thinking of different kinds of lessons.

In picture 1 she or he liked the lesson very much
In picture 2 she or he liked the lesson
In picture 3 she or he neither liked nor disliked the lesson
In picture 4 she or he disliked the lesson
In picture 5 she or he disliked the lesson very much

NOW YOU MAY TELL HOW YOU LIKE DIFFERENT KINDS OF LESSONS.
MARK WITH A CROSS THE PICTURE WHICH BEST MATCHES THE LESSON.

LET'S FIRST DO AN EXERCISE:

Mark on the following lines
how you like:

A good tv-program	_____	_____	_____	_____	_____
An aching finger	_____	_____	_____	_____	_____
The teacher delivering booklets	_____	_____	_____	_____	_____

How do you like the following tasks ?
Think of some lesson in your class !

Working alone	_____	_____	_____	_____	_____
Observing birds in the zoological museum	_____	_____	_____	_____	_____
Looking for information on bird-video	_____	_____	_____	_____	_____
Working in a group	_____	_____	_____	_____	_____

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KASVATUSTIETEIDEN TUTKIMUSLAITOKSEN JULKAISUSARJA A. TUTKIMUKSIA
ISSN 0782-9809
Institute for Educational Research. Publication series A. Research reports
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KASVATUSTIETEIDEN TUTKIMUSLAITOKSEN JULKAISUSARJA C. TIEDOTTEITA
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Institute for Educational Research. Publication series C. Bulletin
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ISSN 0782-9817

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